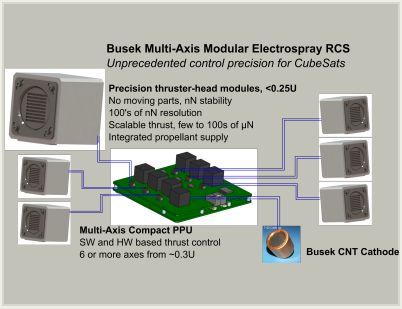
Milliarcsecond Small Spacecraft Attitude Control System, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

Busek proposes to develop a highly modular attitude control system (ACS) which will provide orders of magnitude improvements over state-of-the-art alternative ACS for CubeSats. The low inertia of CubeSats combined with vibrational disturbances and resolution limitations of state-of-the-art ACS presently limit body-pointing and position control accuracy. Busek's electrospray thrusters aboard the ESA LISA Pathfinder spacecraft recently demonstrated precision control at nm scales; this work extends that success to CubeSat platforms. Passively fed electrospray thrusters are highly compact, including fully integrated propellant supplies, and are capable of ~100nN thrust at 10's of nN noise. Thrust can be throttled over >25x, to a scalable maximum of 10's of uN. These traits, combined with >1200s Isp enable these systems to replace traditional reaction wheel ACS; improving pointing error from arcsecs to 10's of milliarcsec. This work addresses critical development gaps, in both thruster-heads and a multi-axis power processing unit with integrated firmware, presently gating the technology. Phase I will focus on establishing a baseline set of data and methodologies permitting detailed verification of the technology and definition of development gaps. The output of existing designs will be scaled to target ACS applicable performance in Task 1, culminating in assembly of two thrusters. A precisely measured performance map including thrust range, resolution and noise will be measured in Task 2 from both thruster heads. Those data will permit PPU system requirements to be defined and will feed development of control laws to be evaluated, in Task 3, using a hardware-in-the-loop precision pointing test apparatus. Electronics requirements will be assessed against existing single-axis architectures and new HV converter measurements in Task 4, along with identification of thruster head development needs; establishing a path towards a full system development in Phase II.



Milliarcsecond Small Spacecraft Attitude Control System, Phase I Briefing Chart Image

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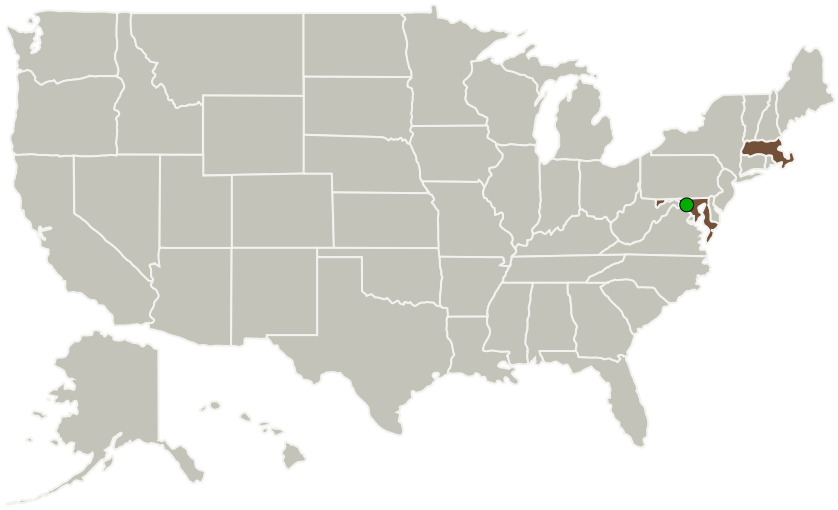
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	Massachusetts

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

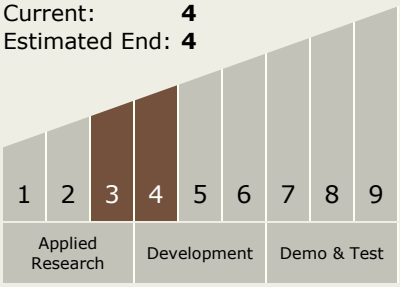
Carlos Torrez

Principal Investigator:

Daniel Courtney

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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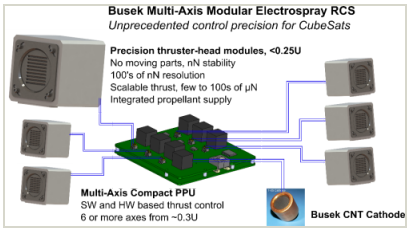
Images



Briefing Chart Image
Milliarcsecond Small Spacecraft Attitude Control System, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/127445)*

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic